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Assessment of salt knowledge and habits in patients with high low-density lipoprotein cholesterol

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ABSTRACT

Aims: Excessive dietary salt intake is a major contributor to cardiovascular morbidity and mortality. Patients with elevated low-density lipoprotein cholesterol (LDL-C) are at increased risk, but there is limited data on their salt knowledge and habits. This study aimed to assess salt-related knowledge and dietary behaviour in patients with hyperlipidaemia.

Methods: A prospective cross-sectional study was conducted among 100 patients with LDL-C ≥160 mg/dl attending the Internal Medicine Outpatient Clinic of Ondokuz Mayıs University. Participants completed three face-to-face questionnaires assessing demographic and clinical characteristics, salt knowledge (20-item test), and frequency of consumption of salty foods. Data were analysed using descriptive statistics and comparison tests (t-test, Mann-Whitney U, Chi-square), with $p<0.05$ considered statistically significant.

Results: Salt knowledge scores ranged from 5 to 19 correct answers. Patients with higher education had significantly better salt knowledge ($p<0.0001$), whereas older adults and married individuals had lower scores. There were no significant differences according to sex, BMI or self-reported low-salt diet. Only 10% of participants reported receiving education about salt intake. Feta cheese was the most commonly consumed salty food, while unsalted bread was rarely preferred. Despite high LDL-C levels, many patients lacked an adequate understanding of the health risks associated with salt.

Conclusion: There is a substantial gap in salt-related knowledge in patients with high LDL-C, particularly in older and less educated individuals. Targeted educational interventions addressing salt consumption may improve dietary practices and support cardiovascular risk reduction in this vulnerable group.

Keywords: LDL cholesterol, salt intake, dietary behavior, hyperlipidemia

INTRODUCTION

Cardiovascular diseases (CVD) remain the leading cause of morbidity and mortality worldwide, accounting for approximately 17.9 million deaths annually, with elevated low-density lipoprotein cholesterol (LDL-C) identified as a major modifiable risk factor.[1] Elevated LDL-C promotes atherosclerosis by facilitating lipid accumulation within arterial walls, contributing to plaque formation and vascular inflammation. Pharmacological interventions, such as statins, have been shown to be effective in lowering LDL-C levels. However, lifestyle modifications, particularly dietary interventions, are also essential for comprehensive cardiovascular risk reduction.[2]

Excessive dietary salt intake has been associated with the development and progression of hypertension, endothelial dysfunction and left ventricular hypertrophy, all of which increase the risk of CVD events.[3] In addition, several studies suggest that high sodium intake may adversely affect lipid metabolism, potentially exacerbating dyslipidaemia by increasing serum total cholesterol and LDL-C levels.[4] Despite global recommendations for a daily salt intake of less than 5 g, actual consumption remains significantly higher in most populations.[5] The interplay between salt intake and lipid parameters, including LDL-C, highlights the importance of public awareness and individualised dietary counselling in patients with dyslipidaemia.[2,3]

In this context, patients knowledge and behaviours regarding salt consumption play a critical role in disease prevention and management. Previous research has highlighted significant gaps in the publics understanding of hidden dietary sources of sodium, recommended intake levels and the health effects of excessive salt consumption.[6] This study aims to assess the level of salt-related knowledge, attitudes and consumption habits in patients with high LDL-C. By identifying behavioural patterns and potential knowledge deficits, this research aims to inform targeted dietary education strategies that may contribute to improved lipid control and overall cardiovascular health.

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METHODS

Ethics

The study was carried out as a thesis at Samsun Ondokuz Mayıs University in 2013 (Thesis No: 340568). Prior the study, institutional approval was obtained. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Study Design and Setting

This study was designed as a prospective cross-sectional analysis and was conducted between 2012 and 2013 at the Internal Medicine Outpatient Clinic of Ondokuz Mayıs University Faculty of Medicine.

Study Population

A total of 100 adult patients (aged ≥18 years) with hyperlipidemia and serum LDL-C levels ≥160 mg/dl were included. Exclusion criteria included the presence of chronic renal insufficiency, diabetes mellitus, high salt intake due to hypotension, and moderate to poor general health that might affect participation or data reliability.

Data Collection Tools

A structured 14-item questionnaire was developed to assess the personal and clinical characteristics of the participants. Seven items focused on demographic variables, while the remaining questions covered duration of hypercholesterolaemia, presence of comorbidities, use of cholesterol-lowering medication, most recent LDL-C level, most recent blood pressure measurement and, for hypertensive patients, seven additional questions related to blood pressure management.

Salt knowledge was assessed using a 20-item multiple-choice questionnaire. This instrument included seven questions to assess general knowledge about salt and its health effects and 13 questions to assess awareness of the salt content of various commonly consumed foods. The questionnaire was developed using a combination of evidence-based sources, including dietary guidelines related to hyperlipidaemia, scientific publications on food content and salt intake, and national data from the Turkish Ministry of Health on the salt content of various foods. In addition, general information on dietary salt and its health effects, as well as food-specific sodium content, was included based on relevant educational materials and previous literature.[7-9]

Dietary habits were assessed with a questionnaire focusing on the frequency of consumption of high-sodium foods traditionally consumed in Turkiye, such as pickles, feta cheese, bagels/pastries and salted nuts. Participants were also asked about the frequency of eating out, daily bread consumption and the use of unsalted bread.

All questionnaires were administered in face-to-face interviews by trained researchers to ensure data consistency, accuracy and completeness.

Statistical Analysis

The data analyses were performed using appropriate parametric or non-parametric tests based on the distribution of the data. Student's t-test or Mann-Whitney U test was used to compare continuous variables between two independent groups. Categorical variables were analysed using the Chi-square test or Fisher's exact test, where appropriate. A two-tailed p-value<0.05 was considered statistically significant.

RESULTS

A total of 100 patients with elevated LDL-C levels (≥160 mg/dl) were included in the study. The majority were male and under 60 years of age. Most participants had a low level of education and a large proportion were illiterate or had only completed primary school. The most common occupational groups were civil servants and homemakers. Nearly two-thirds of participants reported comorbid conditions, with hypertension being the most common, followed by coronary heart disease and other chronic conditions such as hypothyroidism and hepatic steatosis. Detailed demographic and clinical characteristics of the study population are shown in **Table 1**.

Table 1. Demographic and clinical characteristics of patients and their salt knowledge test scores

Variable	n (%)	Salt knowledge score (mean±SD)	p-value
Age			
<60 years	62 (62)	13.3±2.58	<0.0001
≥60 years	38 (38)	10.8±3.03	
Sex			
Female	56 (56)	12.0±3.06	<0.124
Male	44 (44)	12.6±2.93	
Education level			
Primary school or below	68 (68)	11.6±2.70	<0.0001
Secondary school and above	32 (32)	15.0±2.18	
Marital status			
Married	86 (86)	12.1±2.97	<0.0001
Single/divorced/widowed	14 (14)	13.9±2.65	
Comorbid conditions			
Hypertension (+)	41 (41)	12.8±3.29	0.038
Hypertension (-)	59 (59)	12.4±2.81	
CAD (+)	24 (24)	12.4±3.62	0.007
CAD (-)	76 (76)	12.7±2.96	
BMI			
≥30	30 (30)	13.0±3.10	>0.05
<30	70 (70)	12.0±3.03	

CAD: Coronary artery disease, BMI: Body-mass index

The 20-question salt knowledge test yielded scores ranging from 5 to 19 correct answers. When test scores were analysed by demographic and clinical characteristics (**Table 1**), patients under 60 years of age scored significantly higher than those aged 60 years and older (p<0.0001). Similarly, patients with a higher level of education had significantly better salt knowledge than those with only primary education or no formal education (p<0.0001). Married individuals and women had lower mean scores than their counterparts (p<0.0001 for both comparisons) (**Table 1**).

Patients with hypertension and those with CVD had slightly higher scores, with statistically significant differences observed (p=0.038 and p=0.007, respectively). However, there was no statistically significant difference in salt knowledge scores between obese (BMI ≥30) and non-obese patients (p>0.05). In addition, no correlation was found between salt knowledge scores and measured blood pressure or LDL-C levels (**Table 1**).

Of the participants, 58% considered their meals to be low in salt, 39% described them as normally salted and 3% reported higher than normal salt levels. When asked if they followed a low-salt diet, 45% said they did and 55% said they did not. There was no statistically significant difference in salt knowledge scores between those who reported following a salt restricted diet and those who did not (p>0.05). Similarly, no significant difference was found between patients who reported adhering to a salt restricted diet (42%) and those who did not (58%) (p>0.05).

Only 33% of patients were aware that they needed to reduce their salt intake and only 10% had received formal education about salt and its health effects. Sources of information included doctors (30%), nurses (20%), dietitians (10%), peers (10%) and other sources (30%).

The dietary habits of the participants with regard to high-salt foods are summarised in **Table 2**. The most commonly consumed salty food was feta cheese, consumed daily by 68% of patients. Pastries such as bagels, simit and börek were consumed weekly by 29% of the patients. Only 9% of participants reported daily consumption of unsalted bread.

Table 2. Frequency of consumption of selected salty foods

Food item	Daily n (%)	1–3 times/week n (%)	Less than once/week n (%)
Pickles	3 (3.0)	14 (14.0)	83 (83.0)
Feta cheese	68 (68.0)	20 (20.0)	12 (12.0)
Pastry (simit/börek)	9 (9.0)	29 (29.0)	62 (62.0)
Salted nuts	1 (1.0)	17 (17.0)	82 (82.0)
Eating out	11 (11.0)	5 (5.0)	84 (84.0)
Unsalted bread	9 (9.0)	20 (20.0)	71 (71.0)

In terms of bread consumption, 51% of patients ate less than half a loaf a day, 38% ate between half a loaf and a loaf, and 11% ate more than a loaf a day. While 44% of patients reported that meals were cooked without salt at home, only 16% reported that special meals were prepared for them, of which 2% were low-salt, 6% low-fat and 8% both low-fat and low-salt. In addition, 6% of patients used artificial salt and 7% reported adding salt to food before tasting it.

DISCUSSION

Salt, which plays a fundamental role in maintaining intravascular and extravascular volume is essential for human life. However, several studies have shown that excessive salt consumption is associated with many health problems, including hypertension, CVD, metabolic syndrome, cancer, osteoporosis and autoimmune diseases.[10-16]

The health problems caused by a high-salt diet are increasingly recognised, and the World Health Organisation (WHO) recommends that daily salt intake should not exceed 5 g.[17] However, due to cultural differences, the average in many countries exceeds 8 g.[18] The SALTURK study conducted in Turkiye reported an average daily salt intake of 18 g.[19]

Hyperlipidaemia is one of the most important independent risk factors for coronary heart disease. Many studies have shown that endothelium exposed to oxidised forms of LDL-C leads to impairment of endothelium-dependent vasodilation with increasing exposure time.[20]

This study assessed salt knowledge and dietary habits in people with high LDL-C, a group at high risk of cardiovascular disease. The results showed that salt knowledge scores were lower in older age groups, those with a low level of education and married people. Although the general level of awareness is moderate, lack of knowledge about salt intake and its effects on health is still widespread, even in high-risk groups.

Previous studies have shown that excessive salt intake has adverse effects not only on hypertension, but also on lipid metabolism and vascular function, and thus may accelerate the progression of atherosclerosis in hyperlipidaemic individuals.[3,21-23]

It has been reported that 86% of hypertensive individuals in the USA exceed the recommended daily sodium intake of 2.3 g.[24] In our study, no significant difference was observed between hypertensive and normotensive individuals in the preferred salt content of meals. Forty-two per cent of the participants reported that they ate their meals with normal or more than normal salt.

Although 58% of respondents reported having a low/normal salt diet, this behaviour was not associated with higher knowledge scores. This suggests that salt restriction is mostly based on medical advice or routine habits, rather than on a conscious knowledge base.

Education level emerged as a strong determinant of salt knowledge, in line with previous studies.[25] Individuals with at least secondary education had significantly higher knowledge scores than those with only primary education or no education. These results highlight the importance of tailoring dietary recommendations and educational interventions to individuals' health literacy.

The relationship between hypertension and dietary sodium intake has been confirmed in many studies, and obesity is known to be an independent risk factor for hypertension.[26,27] A study conducted in China showed that blood pressure in patients with metabolic syndrome was associated with increased salt sensitivity.[28] In addition, some studies have reported that high salt intake also promotes the development of obesity.[29,30] However, this study did not find a significant difference in salt knowledge scores between obese and non-obese individuals. This suggests that salt knowledge may be independent of body composition and that messages for at-risk groups should be disseminated throughout society.

Another striking finding was that the proportion of people who had received formal education about salt was only 10%. The majority of participants said they received their information from doctors. This finding suggests that health professionals should play a more active role in educating patients. Structured counselling practices during clinical visits can help to fill knowledge gaps.

Processed foods contain high levels of salt for reasons such as enhancing flavour, prolonging shelf life and preventing microbial growth.[31] According to the WHO, the main sources of salt are processed products, ready-to-eat meals and salt added during food preparation or at the table.[32] In a global meta-analysis of dietary salt sources, bread, cereal products, meat and dairy products were shown to be the main sources.[33] It is estimated that 25-40% of the daily salt intake in the USA and other western countries comes from bakery products.[34]

This study provides important insights by showing that individuals with high LDL-C levels have increased salt intake depending on their dietary habits. Our results showed that this group often consumed high-salt foods such as cheese and pastries, which is consistent with trends reported in the literature. It is known that 100 g of bread in Turkiye contains approximately 1.5-2 g of salt and according to the SALTURK 2 study, 34% of the total salt in Turkiye comes from bread.[35,36] In our study, approximately half of the patients consumed more than half a loaf of bread per day, which is not only a carbohydrate but also a significant source of salt. Unfortunately, the consumption of unsalted bread was quite low.

On the other hand, the habit of preparing food at home was more common than eating out, and 44% of patients reported cooking their meals without salt. This suggests that food preparation and consumption habits are culturally based and that these cultural factors should be taken into account in salt reduction strategies.

Although this study did not find a significant association between salt knowledge and LDL-C levels or blood pressure, it is important to remember that knowledge alone is not always effective in changing behaviour or clinical outcomes. Behaviour change is a complex process and requires ongoing interventions, environmental support and repeated incentives.

Important strengths of the study are that it was conducted using a structured face-to-face questionnaire and with a well-defined patient population. However, the cross-sectional design limits the ability to establish causal relationships, and self-report of dietary behaviour may be subject to recall or social desirability bias. In addition, the study was conducted in a single centre, which limits the generalisability of the findings.

Limitations

This study has several limitations that should be considered when interpreting the results. First, the cross-sectional design of the study precludes the establishment of causal relationships between salt knowledge and dietary behaviour or clinical parameters such as LDL cholesterol and blood pressure. In addition, the study was conducted in a single centre with a relatively small sample size, which limits the generalisability of the results to larger populations. Furthermore, although efforts were made to validate the salt knowledge questionnaire through expert review and pilot testing, the instrument was not formally validated on a larger scale, which may affect the robustness of the results. Future multicentre studies with longitudinal designs and larger, more diverse samples are needed to confirm and extend these findings.

CONCLUSION

As a result, this study demonstrates a critical need to improve salt knowledge and dietary behaviour in people with high LDL-C. Culturally appropriate and health literacy sensitive educational interventions should be integrated into routine health care for people with hyperlipidaemia. Increased knowledge of the health effects of salt may support more effective dietary changes and strengthen cardiovascular risk management.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out as a thesis at Samsun Ondokuz Mayıs University in 2013 (Thesis No: 340568).

Informed Consent

All patients signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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